

New Spray Bar System Installed in NASA Lewis' Icing Research Tunnel

NASA Lewis Research Center's Icing Research Tunnel (IRT) is the world's largest refrigerated wind tunnel dedicated to the study of aircraft icing. In the IRT, natural icing conditions are duplicated to test the effects of in-flight icing on actual aircraft components and on scale models of airplanes and helicopters. The IRT's ability to reproduce a natural icing cloud was significantly improved with the recent installation of a new spray bar system. It is the spray bar system that transforms the low-speed wind tunnel into an icing wind tunnel by producing microscopic droplets of water and injecting them into the wind tunnel air stream in order to accurately simulate cloud moisture.

The spray bars and supporting mechanical and electrical systems were designed in-house by Lewis' Engineering Design and Analysis Division and Lewis' Facilities and Test Engineering Division. Accurate Machine Tool Company of Cleveland, Ohio, fabricated and assembled the spray bars, and North Bay Construction, Inc., also of Cleveland, installed the spray bars and the supporting mechanical system. The electrical system was installed in-house by Lewis' Facilities and Test Engineering Division and Lewis' Test Installation Division.

The spray bars are located in the wind tunnel settling chamber upstream of the test section. There are a total of 10 spray bars, which hold a total of approximately 130 air-assist atomizing water nozzles. In each of the 10 spray bars, there are two water headers that feed the water nozzles; every header can be independently pressurized. This allows for step-function-type changes in the liquid water content of the icing cloud. At every nozzle location, solenoid valves control the water flow to the headers for that particular water nozzle. Each spray bar has an external cover that is an aerodynamically shaped fairing with a removable trailing edge. This feature allows for easy maintenance of the interior mechanical and electrical components.

Measurable improvements associated with the new system include an order-of-magnitude decrease in the time required to achieve a uniform icing cloud in the test section (from approximately 1 minute to less than 10 seconds), a greater than 100 percent increase in the size of the uniform cloud (from 15 to more than 30 ft²), and the creation of ice shapes similar to those produced by the previous spray bar system. After installation of the new spray bar system, test section aerodynamic calibrations and icing cloud calibrations—including the important parameters of icing cloud uniformity, droplet size distribution, liquid water content, and ice shape comparisons—were successfully completed.

The improved performance characteristics associated with the new spray bar system ensure the IRT's capability to re-create in-flight icing conditions, thus guaranteeing that the facility will continue to contribute to its primary goals, including computer simulation validation, ice accretion shape generation, ice protection system research and development testing, and aircraft ice protection system certification.



New spray bar system for Lewis' Icing Research Tunnel as seen from the test section.

Lewis contact: Thomas B. Irvine, (216) 433-5369, Thomas.B.Irvine@grc.nasa.gov

Author: Thomas B. Irvine

Headquarters program office: OASTT

Programs/Projects: Aeronautics Base R&T